JPSS Proving Ground Periodic Reporting
Project Team: OceanWatch

Reporting Period: Jan 2013 - Mar 2013

Team Lead: Kent Hughes
Team Members: Heng Gu, Phillip Keegstra, Sathya Ramachandran, Ron Vogel**,** Michael Soracco, Yong Sung Kim, Rick Stumpf (NOS), Howard Townsend (NMFS), Eric Bayler (NWS/NCEP – STAR), Davida Street (NESDIS/SAB)

Project Title: **Global VIIRS Ocean Color Pre-Operational User Expansion, User Specified Independent Quality Assessment, Product Development/Support, and Next Generation Distribution Portal Deployment**

Executive Summary

The CoastWatch/OceanWatch Global VIIRS Ocean Color project seeks to expand usage of satellite ocean color data from the VIIRS instrument on Suomi-NPP. The project engages users identified to have a high-potential need for ocean color data, including NWS, NOS, NMFS, and NESDIS. In order to support expanded ocean color needs, the project collaborates with these users to establish requirements, develops new data processing capabilities to meet those requirements, conducts quality assessments and comparisons of VIIRS ocean color data as specified by the users, and enhances the online distribution portal to meet the needs of the users, scientists and the public.

Work this quarter focused on: 1) continued engagement with the project collaborators to further establish VIIRS ocean color data requirements, 2) fulfill user requirements for quality monitoring and algorithm cross-comparison of the ocean color products, 3) attempt to expand data processing to full global processing, and 4) complete several phases of the data distribution portal development.

Importantly in this quarter, the quality work has completed the VIIRS ocean color algorithm cross-comparison for allowing algorithm selection for operational data processing. The operational users have provided their feedback on the algorithm cross-comparison and have weighed in on their algorithm choice. In addition, the ocean color quality work uncovered SDR and EDR quality issues that were then transmitted to the NOAA VIIRS SDR & EDR calibration/science team leads for calibration or algorithm improvements.

Overall Status: **Green**

	Green [1] (Controlled)	***Yellow*** [2] (Caution)	***Red*** [3] (Critical)	**Deviation Summary**[4]
Budget	☒	☐	☐	
Schedule	☐	☒	☐	System trouble encountered ramping up VIIRS processing to global.
Scope	☒	☐	☐	

[1] *Project is within budget, scope and on schedule.*
[2] *Project has deviated slightly from the plan but should recover*
[3] *Project has fallen significantly behind schedule, is forecast to be significantly over budget, and/or has taken on tasks that are out of scope.*
4Details of deviations provided in subsequent section of report

Comments:

Trouble has been encountered when ramping up VIIRS data processing from regional to global. System troubleshooting is underway to identify the problem. If solved through troubleshooting, there may be a quick ramp-up to global processing, or the troubleshooting may identify more generic problems with the system design. If problems stem from the generic design of the system, a system redesign may be necessary, which will impact schedule and budget for the current year's funding.

Scheduled Milestones / Deliverables

Milestone	Approved Schedule	Start Date	Forecasted Completion	Actual Completion	Comments	Status
Expand Operational Users						
New NWS user requests received	9/2012	9/2012	9/2012	9/2012	VIIRS data needs for RTOFS testing defined.	Green
New NOS user requests received	10/2012	9/2012	10/2012	9/2012	NOS has reviewed algorithm QA results and provided feedback.	Green
NMFS (NCBO) ability to import chl into ecosystem model	8/2013	9/2012	8/2013	2/2013	Completed ahead of schedule, so model experiments will begin early in next quarter.	Green
New SAB user request received	11/2012	5/1/2013	9/30/2013		Delay in user request evolution.	Yellow
Independent VIIRS Ocean Color Quality Assessment						
QA requirements collected/exposed	12/2012	9/2012	12/2012	11/2012	All users have provided input on their QA needs.	Green
VIIRS OC compared with NASA climatology	9/2012	9/2012	9/2012	9/2012	Completed, runs in NRT.	Green
QA statistics stratified (NOS)	8/2013	9/2012	8/2013	2/2013	Completed ahead of schedule for informing algorithm selection.	Green

Develop/Deploy New Products						
Foundational global processing implemented	3/2013	9/2012	TBD		Troubleshooting in progress to identify processing problem.	Yellow
Products deployed in STAR domain	6/2013	9/2012	TBD		Pending (above). THREDDS server installed.	Yellow
Script to convert CW format for import to NMFS model grid	6/2013	9/2012	1/2013	1/2013	Completed	Green
M-band true color browse images	9/2012	9/2012	9/2012	9/2012	Completed, also extended to both input data sources.	Green
Develop/Deploy Next Generation Data Portal						
New search criteria added: Operational vs Experimental identification on web portal	12/2012	9/2012	3/2013	3/2013	Completed and available to public.	Green
New search criteria added: Selection by daily, weekly, monthly composites	8/2013	4/2013	8/2013		Development will start shortly.	Green
When data search yields no results, replace "no results" with time range of available data	12/2012	9/2012	3/2013	3/2013	Completed and available to public.	Green
Google map interface for global L2	3/2013	9/2012	3/2013		Pending availability of browse images from global data processing.	Yellow
Distribution of global reduced res data files offered	6/2013	9/2012	3/2013		Pending (above). THREDDS server installed.	Yellow

Status Definition: Green (will meet schedule), Yellow (milestone will be delayed), Red (milestone cannot be met on current path)

Accomplishments & Plans

Accomplishments During this Reporting Period

New VIIRS quality assurance capabilities were completed ahead of schedule in order to inform VIIRS chlorophyll algorithm selection for operational processing. The NOS user was extremely pleased with the ability to assess the quality of both VIIRS algorithms using the new capability that had been requested by NOS. These new QA capabilities include the stratification of chlorophyll statistics for each algorithm by chlorophyll concentration, distance from shore, and bathymetry (Figure 1).

Meetings were held with the operational users to discuss quality issues with the VIIRS ocean color algorithms. Since only one algorithm is expected to be selected for operational processing (at NESDIS/OSPO), the users weighed in on the algorithm assessment to inform an algorithm recommendation. Additional user feedback suggested changes to the SDR calibration and ocean color algorithm (Figure 2), which were then transmitted to the NOAA VIIRS SDR calibration and EDR science team leads for calibration and algorithm improvements.

The NMFS ecosystem modeling component progressed substantially with the completion of the capability to convert the CoastWatch-HDF format to the Atlantis ecosystem model grid (Figure 3), which is ahead of schedule. As a result, ecosystem model experiments were defined, and data collection of the satellite chlorophyll began for the model runs to begin in April.

Global processing of VIIRS data met a stumbling block with system errors during this reporting period. It appears that regional and global system processes are in conflict. Troubleshooting is underway. If a solution is found, ramp-up to global processing may be imminent, but the troubleshooting may also reveal that the system design may not be capable of global processing, in which case a system redesign may be necessary. Any schedule or funding impacts will be communicated with JPO.

Processing capability was expanded to generate true-color browse images from either the IDPS or NASA-L2gen data processing streams. This ensures the generation of global browse images no matter which algorithm-stream is selected for operational processing.

Aspects of the Data Portal were successfully completed and deployed on the search interface for public searching of VIIRS data (Figure 4). Other aspects were also completed, such as the new VIIRS Level-2 global browse capability, but were not deployed in this reporting period as planned, because the generation of the browse images depends on the global processing. Deployment is pending a resolution of the global processing. Furthermore, the THREDDS server, intended for distribution of large full-resolution global VIIRS files (a distribution capability separate from the web portal and funded outside of JPSS), made excellent progress with completion of the server set-up in STAR's IT computing environment.

Additional Information

1. Interaction with operational partners – NWS/NCEP/EMC – Meeting held Feb 4, 2013. The partners discussed inclusion of VIIRS ocean color data (chlorophyll and Kd-490) in EMC's Real-time Ocean Forecast System (RTOFS) for NWS operational forecasting. The partners agreed that by June 2013, CoastWatch will provide a daily 4km global VIIRS chlorophyll data set (in NetCDF4 format) to EMC for their data ingestion software testing only. Furthermore, CoastWatch will accumulate one year of 4km global VIIRS chlorophyll data sets by June 2014 and provide them to EMC for their forecast model application, then continue providing data sets on a daily basis. VIIRS ocean color algorithm choices were discussed, but EMC is open to accept any one of them at this time. Further QA discussion on algorithms will be held.

NMFS/NCBO – Meeting held Feb 13, 2013. Capability was completed ahead of schedule to convert the CoastWatch-HDF format to the format required for input to the Atlantis ecosystem model, so the partners decided that model experiments can begin shortly. Several ecosystem model experiments for Chesapeake Bay fisheries were designed. In addition, obtaining the necessary satellite data for these experiments has begun.

NOS/NCCOS – Meeting held Feb 25, 2013. QA assessments were presented to the partner, quantifying results for both VIIRS chlorophyll algorithms: IDPS and NASA-L2gen. The NOS partner had valuable

feedback on the VIIRS IDPS algorithm, that was then transmitted to the NOAA VIIRS SDR & EDR team leads, who agreed they would take action on IDPS algorithm improvements.

NWS/NCEP/EMC – Meeting held Mar 21, 2013. The QA VIIRS algorithm comparisons were presented to EMC, who stated their criteria for algorithm selection. They will need algorithm/quality consistency between historical data (for RTOFS model spin-up) and NRT daily data (for running model forecasts).

2. Conference/workshop participation – Abstract was submitted and accepted for the NOAA Satellite Conference to be held in April 2013 at NCWCP. Abstract attached at end of this report.

3. Funding concerns – Possible funding impact if data processing system needs redesign to handle global VIIRS data processing.

4. Outside project publicity N/A this quarter

5. Journal articles – N/A this quarter

Plans for the Next Reporting Period:

Troubleshooting of the global VIIRS data processing will continue. Potential impacts to schedule and/or budget will be communicated with JPO.

A recommendation for operational VIIRS algorithm selection will be issued by CoastWatch on April 1, based on the extensive quality assurance and discussion with the collaborators that occurred in this quarter. An operational algorithm decision will be made by the Ocean-Color Product Oversight Panel soon thereafter.

The new QA capability to stratify statistics by various criteria (e.g. chlorophyll concentration) will be set up to run in near real-time. Generation of QA statistics on global VIIRS data products will follow.

Ecosystem modelling of Chesapeake Bay fisheries, utilizing satellite chlorophyll, will commence in the next quarter.

Development of the new portal capability to allow searching by temporal period (i.e. daily, weekly or monthly files) will begin.

VIIRS ocean color data will begin to populate the newly installed THREDDS server in STAR. Thus initiating a broader "pathfinder" capability for experimental/preliminary data dissemination from S-NPP and JPSS.

Key Graphics & Supplemental Information

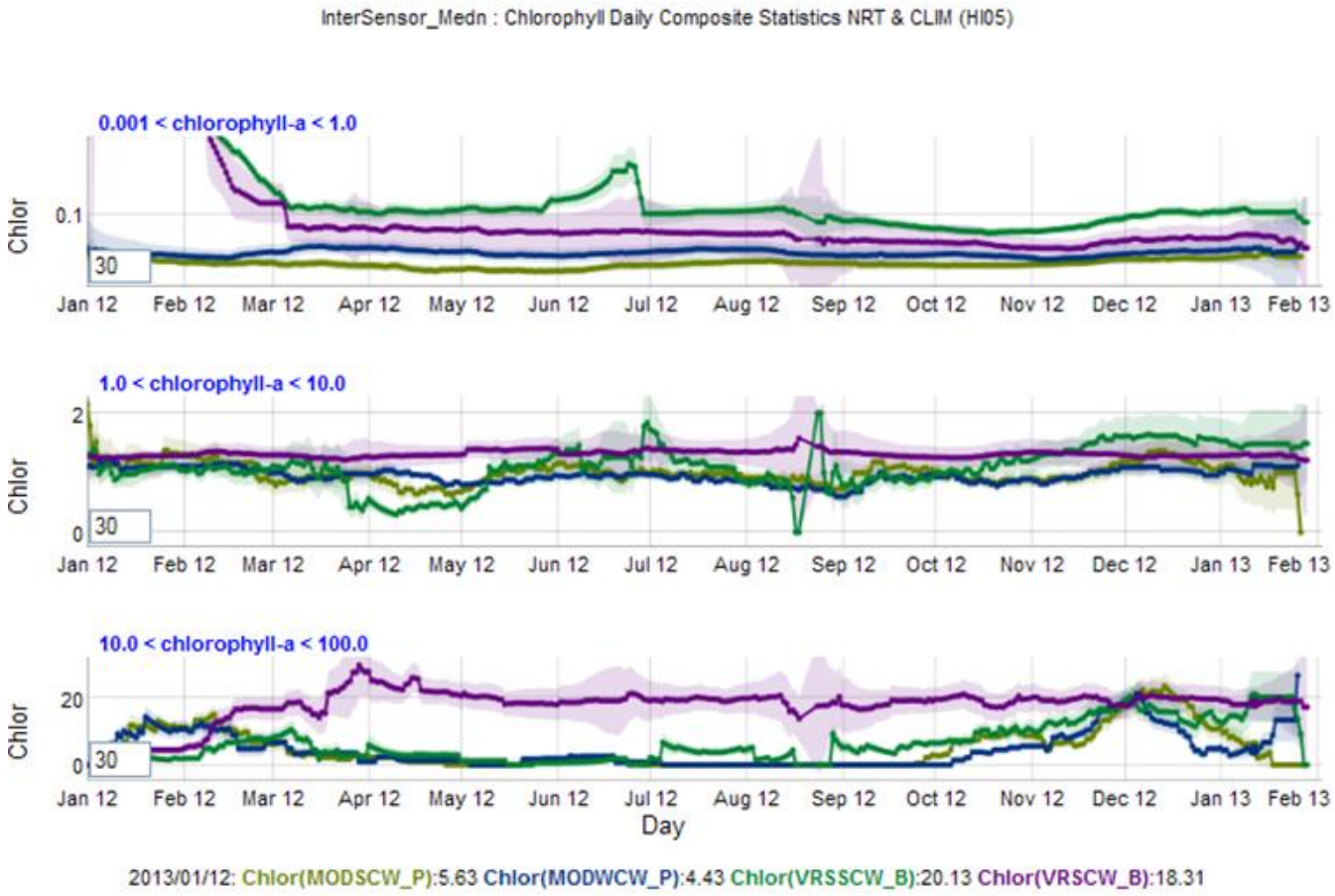
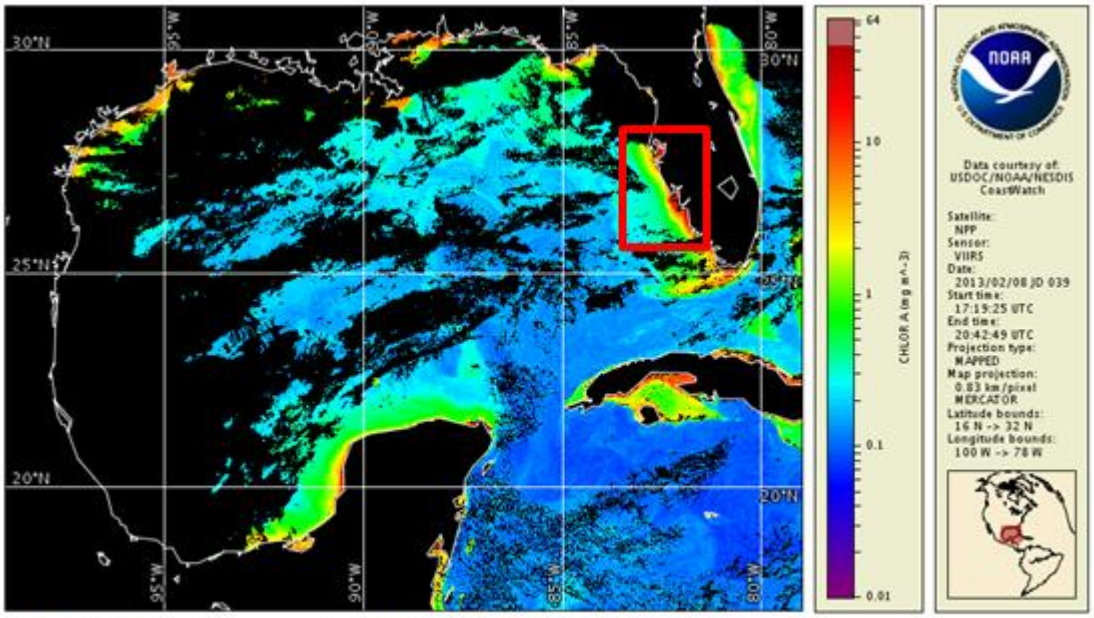
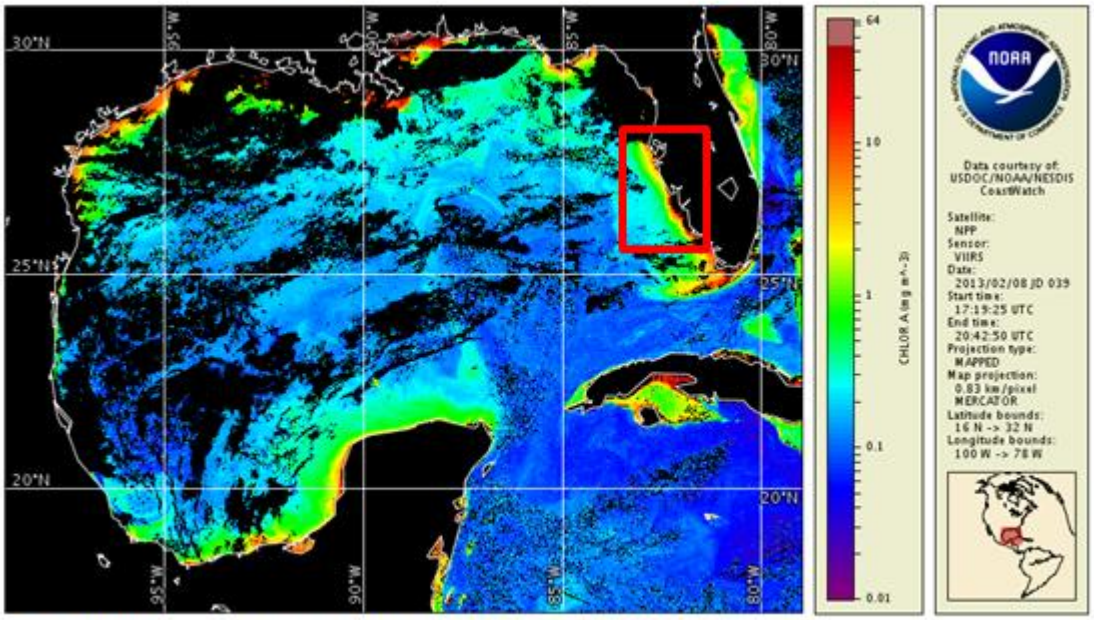


Figure 1. Quality Assurance capability to stratify chlorophyll statistics by chlorophyll concentration for multiple sensors/algorithms: Hawaii region 30-day running average daily median chlorophyll for Jan 2012 – Feb 2013, stratified by concentrations <1.0 mg/L, 1.0-10.0 mg/L, and 10.0-100.0 mg/L, for 4 sensors/algorithms: MODIS-L2gen (yellow), MODIS-SWIR (blue), VIIRS-L2gen (green), and VIIRS-IDPS (purple).



a) VIIRS chlorophyll (L2gen algorithm)



b) VIIRS chlorophyll (IDPS algorithm)

Figure 2. VIIRS chlorophyll for Gulf of Mexico on Feb 8, 2013 for 2 different algorithms: a) NASA-L2gen, and b) IDPS. Quality assurance assessment of chlorophyll quality masks reveals that aggressive coastal masking in IDPS prevents detection of high chlorophyll features known to be Harmful Algal Blooms occurring on the Florida coast.

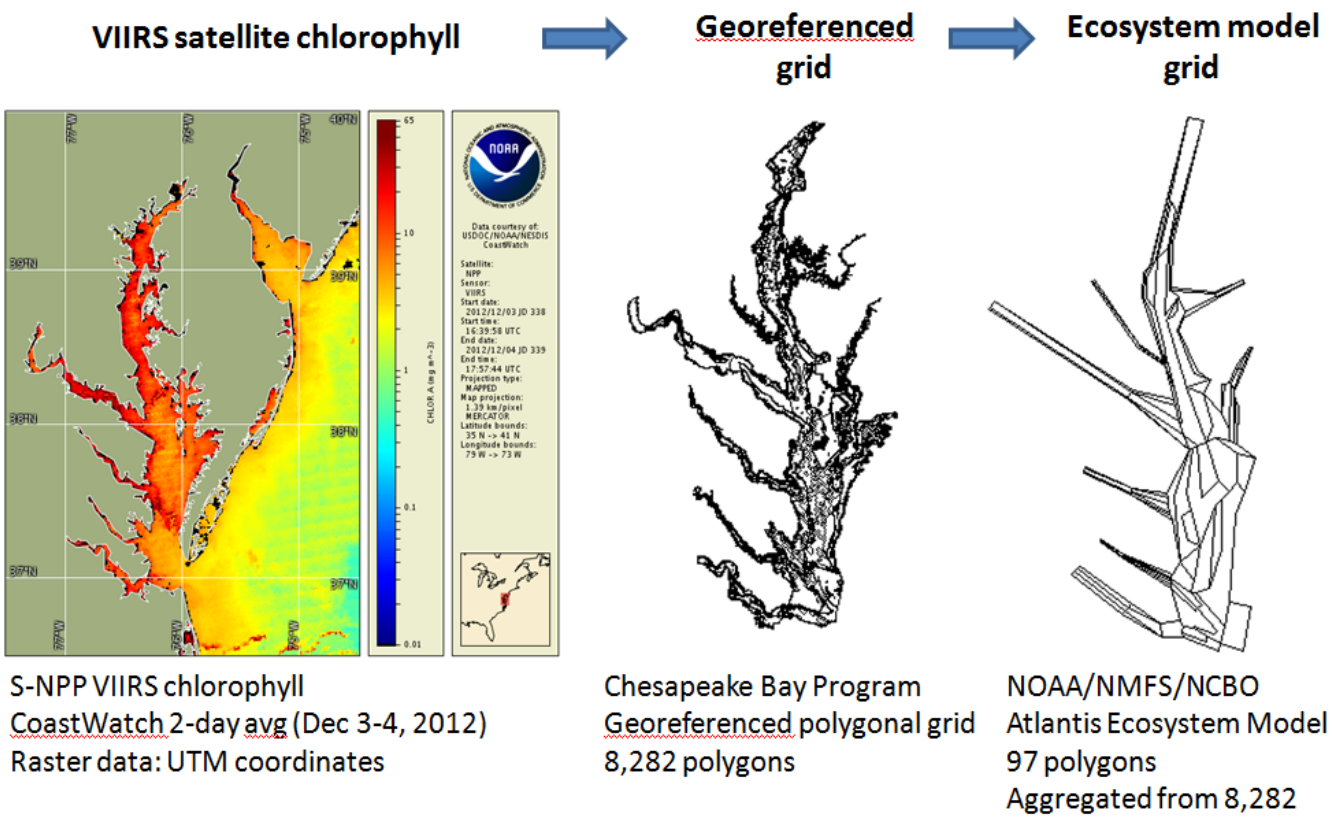


Figure 3. Schematic diagram showing the steps in the conversion of VIIRS satellite data in CoastWatch-HDF format to the Atlantis ecosystem model grid. The conversion process enables satellite data to be used as input to the Atlantis ecosystem model for Chesapeake Bay fisheries modelling.

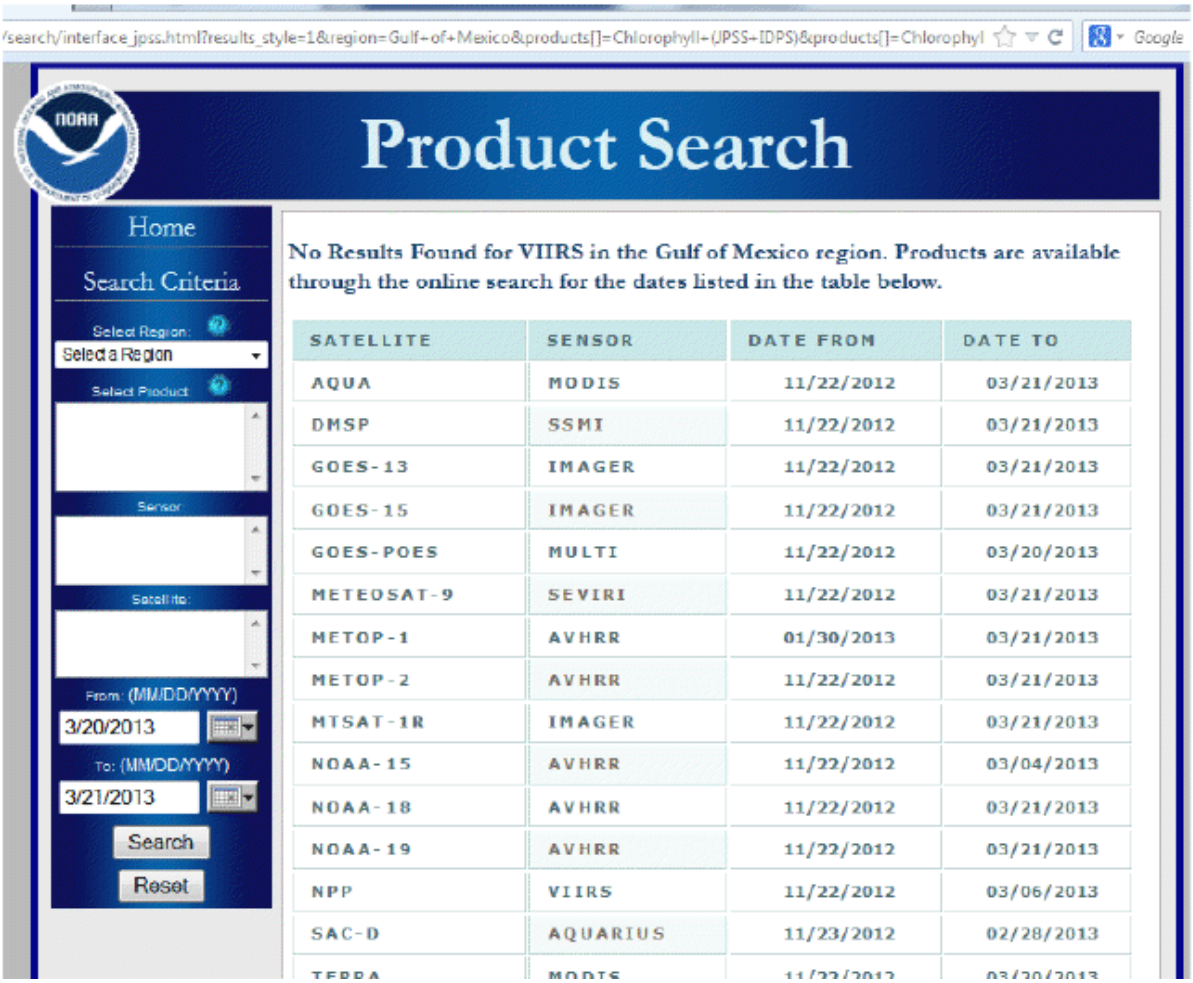


Figure 4. Data Portal display of available data sets and their time ranges when a search does not return any results. With this information, users will be able to resubmit a search based on the available data.

Project Deviation Details

Issues[1]:

- None

Change Status[2]:

- Possible project modifications in emphasis/direction could require consultations with Project Sponsors. Actions resulting from the recommended processing approach and subsequent efforts to "operationalize" NOAA Unique Ocean Color Products will need to be monitored.

Risk Status[3]:

- **Risk:** N/A
- **Mitigation:** The following activities are being initiated: N/A

[1] Issues requiring resolution by Project Manager.
[2] Changes raised for consideration that change the approved project baselines. Would require approval by the Project Manager
[3] Report on any change in priority or status of major project risks, and any risks discovered since earlier risk assessments along with proposed risk response.

Plans for Second Year Funding

1. **Accelerated NOAA End User Utilization of S-NPP/JPSS Ocean Color via OceanWatch** - At least five projects have been identified to accelerate the utilization of S-NPP/JPSS data by actual NOAA end users in representative operational and science applications. Projects in NWS/NCEP/EMC (data/ product tailoring, product development, quality assessment and sustainment), NOS/NCCOS (AWIPS tailoring, reformatting and visualization, quality assessment and sustainment), NMFS/PIFSC (data transport and local storage in Hawai'i via N-Wave and OceanW), NMFS/NCBO (fisheries model data assimilation), NESDIS/SAB (hi-res product development for natural hazards applications), and OAR (data transport and local storage/utilization in Miami via NWave). Preliminary user discussions have been held, but no budgets and/or schedules have been developed pending discussions with Project Sponsors.

2. International MOBY Based Inter-satellite Calibration - Establishment of an operational/science-based capability using MOBY and other *in situ* data for ocean color calibration of multiple satellites. Based on similar efforts involving geostationary satellites, OceanWatch will explore and execute a collaborative effort involving MOBY measurements as well as counterpart efforts at partners' oceanic measurement sites. Initial conversations have been held between the MOBY PI and international satellite operators (Europe and Japan). Preliminary user discussions have been held, but no budgets and/or schedules have been developed pending discussions with Project Sponsors.

3. **Total Suspended Matter Product Development** - Total Suspended Matter from VIIRS had been an unanticipated data product, but recent coastal sediment plume events have triggered discussion of extending the MODIS algorithm for VIIRS, to meet the needs of NMFS/NCBO and Maryland Dept. of Natural Resources. Effort is underway to estimate the scope of both a 750m VIIRS product and a 375m VIIRS product. A possible redirection of some second-year funding may be essential to jump-start this capability, in order to avoid a data gap in post-disaster monitoring of coastal sediment-plumes, should the MODIS mission end. Preliminary user discussions have been held, but no budgets and/or schedules have been developed pending discussions with Project Sponsors.

Abstract: NOAA Satellite Conference, April 8-12, 2013

Title: **VIIRS NPP Ocean Color Products at NOAA CoastWatch – A First Look**

Authors: Kent Hughes, Heng Gu, Phillip Keegstra, Yong Sung Kim, Sathyadev Ramachandran, Michael Soracco, Ronald Vogel

Following the launch of the Suomi NPP satellite CoastWatch has routinely processed the VIIRS NPP data in near real time mode for two possible choices of the ocean color algorithms made available to us, to produce Ocean Color products. One is the IDPS OC3V empirical algorithm and the other is CoastWatch's implementation of NASA OBPG's L2gen, which is also currently being used for NOAA's heritage products from MODIS on Aqua and Terra and in the past for SeaWiFS and MERIS data streams. For both algorithm streams, current experimental products (Chlor_a, nLw, Chlorophyll Anomaly) are produced for all CoastWatch regions for the CONUS area at full resolution, and additional L3 and L4 products will be created for daily Global coverage at a reduced spatial resolution of 4km. In addition, global data at full native resolution, divided into 24 sectors, will also be made available via a THREDDS server. The L3 and L4 global reduced resolution experimental products will be distributed via the STAR web server initially and later from the CoastWatch and OceanWatch web servers familiar to our current operational users when the products are declared operational after their initial assessment. We also present results from the preliminary Quality Assessment of the Ocean Color products (Chlor_a, nLw) from VIIRS NPP addressing our operational end user requirements. The QA approach includes comparison of VIIRS data with NASA MODIS climatologies. There is an ongoing effort to engage operational users with VIIRS data as a replacement for MODIS for the HAB (Harmful Algal Bloom) bulletin issued by NOAA/NOS for the Gulf of Mexico region off the Florida coast. Other potential operational users of the VIIRS NPP ocean color data are NCEP/EMC for their ocean modeling activities and forecast, for fisheries modeling by NMFS Pacific basin users, and for ecological modeling by the NOAA Chesapeake Bay Office.